

## Overview of Hitachi Ballast Water Purification System “ClearBallast”

Used as ballast for stabilizing hull balance, ballast water usually contains plankton, bacteria, mud, and sand specific to the port from which it was drawn. Most ballast water is discharged in ports of nations different from where it was loaded. Consequently, foreign organisms are discharged along with the seawater, and the resulting impact on marine ecosystems has become an international issue.

To combat this problem, in February 2004, the IMO\*1 Council adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Management Convention). The Convention requires that the IMO Performance Standards\*2 be applied in a stepwise manner to ships undertaking international voyages in line with the year of building and the ballast tank capacity, with all ships required to adopt the standard by 2017. In line with these requirements, there is now a need for ships to be fitted with ballast-water treatment systems.

“ClearBallast” purifies ballast water by combining magnetic separation technology developed for high-speed water treatment during rainy periods and coagulation technology generally used to remove plankton and bacteria at many water treatment plants. In contrast to sterilization-type approaches, the coagulation method does not use chlorine, ozone, ultraviolet light, or other disinfectants, and therefore, the risk of residual chemicals causing secondary contamination is removed. “ClearBallast” offers such advantages as compactness along with high-speed treatment through the use of bacteria flocculation (aggregation of small particles), which enables the use of coarse filters compared with ordinary filtration machines.

“ClearBallast” had to be optimized in line with advanced ship-design techniques to ensure that such a purification device could be installed on ships and could then operate as part of a fully integrated system. For commercialization of “ClearBallast”, joint research was conducted with Mitsubishi Heavy Industries, Ltd. (HQ: Tokyo; President: Hideaki Omiya), and these issues were resolved by combining the technology and know-how of both companies.

### Notes:

\*1. IMO: International Maritime Organization

\*2. Ballast water discharge standards:

| Organism or bacteria class                 | Requirement                           |
|--|---------------------------------------|
| Organisms of 50 µm or larger (Note 1)      | Less than 10 per cubic meter of water |
| Organisms of between 10 and 50 µm (Note 1) | Less than 10 per ml                   |
| Toxicogenic vibrio cholerae (O1, O139)     | Less than 1 cfu (Note 2) per 100 ml   |
| Escherichia coli                           | Less than 250 cfu (Note 2) per 100 ml |
| Enterococcus faecalis                      | Less than 100 cfu (Note 2) 100 ml     |

Note 1: Minimum size dimension. Note 2: cfu (colony forming unit)

### Features:

(1) Enhanced biological and environmental safeguards; promotes soundness of hulls

1. Concern about impact on ecosystems is eliminated. Even organisms growing in an environment consisting only of water treated by this system show no signs of such problems as inhibited growth (confirmed through organism toxicity testing).<sup>\*3</sup>

2. Requiring no use of disinfectants, the system poses no threat of secondary contamination from residual chemicals.

3. The system has no adverse effect on paint or other coatings within the ballast tank (confirmed through corrosion assessment testing). Environmentally friendly, it is conducive to the health of organisms and the environment and the soundness of the hull.

Note:

\*3. Biological toxicity testing: Biological toxicity testing compliant with guidelines set by the OECD (Organization for Economic Co-operation and Development). Culture tests were conducted for marine species *skeletonema* (algae), *apohyale barbicornis* (invertebrate), and *javanica* (type of fish) using treated water.

#### (2) Reduced mud buildup inside ballast tanks

Capable not only of eliminating plankton, bacteria and the like from sea water, the system can also remove sand, mud, and other suspended solids originating from the sea bed before they accumulate in the tank. In addition, it can prevent the buildup of mud consisting of dead organisms within the ballast tanks.

#### (3) Suppression of the breeding of bacteria and algae inside ballast tanks

“ClearBallast” not only inhibits the propagation of bacteria within mud, but because it also removes the bio-essential element phosphorous that is suspended in seawater, the system is able to greatly suppress the proliferation of algae generated in large amounts by red tide or other causes is by chance mixed into the ballast tank.

#### (4) Line-up with explosion-proof specifications

Also being studied is a special version of the system with specifications to prevent explosion, which would make it highly suitable for use in specified areas in oil tankers, liquefied gas tankers, container ships carrying hazardous cargo, chemical tankers, and the like. Plans are being made to acquire additional Japanese government approval for such a version.

#### (5) Efficient power usage

At 21 kW for 200 m<sup>3</sup>/h or 112 kW for 1,600 m<sup>3</sup>/h of ballast water, the system's power consumption is held to a relatively low level, which means that adding extra power-generation capacity is not be needed when the system is installed, and the effect on the ship is effectively minimized.

#### (6) No effect on loading procedures

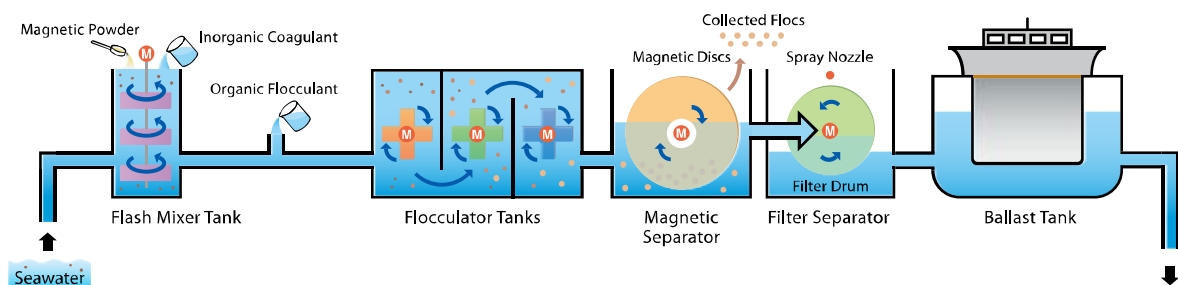
The system treats ballast water during intake, not discharge. Accordingly, no modification is needed to existing procedures used during the loading of cargo.

### **Operation Sequence**

(1) Treatment is done when the water is taken on. First, magnetic power and flocculation agents are added to seawater in a high/low-speed roiling tank, and the water is roiled to form magnetized floc measuring around 1mm consisting of plankton, bacteria, mud, and other material.

(2) When then passed through a magnetic separator, the floc adheres to magnetic disks and is removed. Finally, the treated water is filtered in a filter separator, before being pumped into the ballast tanks.

(3) The system is safe because the plankton and bacteria contained in the recovered floc are killed through heat treatment.



## Shipboard Testing Equipment



## Land-based testing equipment



## Specification (The figures are based on February,2010 designs.)

| Ballast Pump Capacity<br>(m <sup>3</sup> / h ) | Foot print (m <sup>2</sup> ) (Note 1) |                                       |                    |                  |                                      |                                   |               | Electric Power<br>(kW) |
|--|---------------------------------------|---------------------------------------|--------------------|------------------|--------------------------------------|-----------------------------------|---------------|------------------------|
|  | Coagulation Tank                      | Flocculation Tank<br>(Vertical Blade) | Magnetic Separator | Filter Separator | Additive Processing Unit<br>(Note 2) | Collected Flocs Heating Equipment | Control panel |                        |
| 200  | 1.2                                   | 3.3                                   | 4.2                | 4.3              | 4.5                                  | 1.4                               | 1.2           | 21                     |
| 400  | 1.8                                   | 3.7                                   | 6.8                | 7.5              | 8.3                                  | 1.4                               | 1.2           | 31                     |
| 800  | 2.5                                   | 11                                    | 14                 | 16               | 8.3                                  | 2.3                               | 2.0           | 56                     |
| 1,200  | 5.4                                   | 16                                    | 27                 | 28               | 17                                   | 4.6                               | 2.8           | 85                     |
| 1,600  | 5.0                                   | 22                                    | 29                 | 32               | 17                                   | 4.6                               | 2.8           | 112                    |
| 2,400  | 11                                    | 32                                    | 53                 | 56               | 44                                   | 9.2                               | 4.0           | 170                    |

Note 1: Indicates the footprint of each component.

Note 2: Includes the magnetic powder injector , inorganic coagulant injector and organic flocculant injector.

### Notes :

As this system allows flexible equipment layout plans depending on ship's structure, please contact us for details.

1:Equipment can be divided and installed at distant areas, if the installation area is limited.

2:As an alternative to confined space measures, it is also feasible to embed a coagulation tank, flocculation tank, and collected flocs heating equipment into a water tank including a unused ballast water tank.

3:The flocculation tank can be rotated 90 degrees and installed horizontally as option.

4:Then the flocculation tank, the magnetic separator and the filter separator can be installed in a vertical formation.